

# Left main coronary artery occlusion with preserved left ventricular function: a report of three cases

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**SUMMARY** Three patients with angina pectoris are reported in whom occlusion of the left main coronary artery was found at coronary arteriography. In these three patients left ventricular function was well preserved. In all three the right coronary artery was dominant and there were prominent epicardial and septal collateral vessels to the territories normally supplied by the left anterior descending and circumflex arteries.

It seems reasonable to suggest that this coronary artery anatomy and collateral vessel formation accounted for the preservation of the left ventricular myocardium in these patients.

It has recently been proposed that occlusion of a coronary artery is commonly precipitated by rupture of an atherosclerotic plaque followed by superimposed thrombosis.<sup>1</sup> The reduction of local blood flow to the myocardium commonly results in segmental myocardial infarction or sudden death. The extent of the area of infarcted myocardium depends in part on the degree of availability of alternative sources of blood supply. Two mechanisms of alternative blood supply that may be important in reducing the volume of infarcted myocardium are variations in the size and distribution of the coronary arteries and the development of collateral vessels. The degree of development of collaterals may depend on the duration of angina pectoris and the frequency and severity of episodes of myocardial ischaemia; but the time course for development of collateral vessels in man is not known.<sup>2</sup>

We report three patients with angina pectoris in whom occlusion of the left main coronary artery was found at coronary arteriography but in whom little or no impairment of left ventricular function was detectable. The possible contribution of variations in coronary anatomy and of collateral vessel formation to preservation of left ventricular function in such patients is discussed.

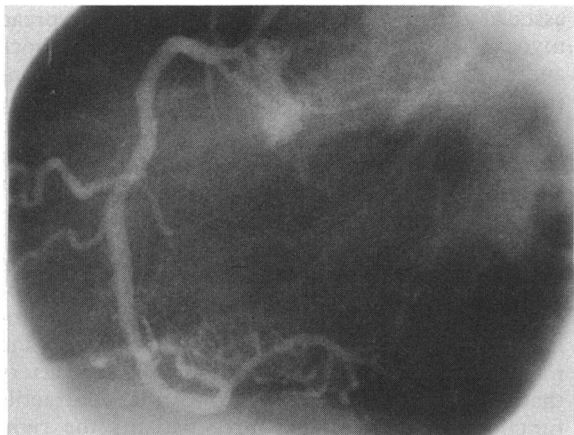
## Patients and methods

### CASE 1

This 60 year old man presented with a two month history of angina pectoris precipitated by exertion. The clinical impression of angina pectoris was confirmed by a positive exercise test. Physical examination was normal. Symptomatic improvement occurred initially on medical treatment, but he continued to experience angina and cardiac catheterisation was performed two years after presentation.

At cardiac catheterisation the left ventricular angiogram was normal; the ejection fraction was 60%. The left ventricular end diastolic pressure was raised, being 15 mm Hg before angiography and rising to 23 mm Hg. The main stem of the left coronary artery was occluded. The right coronary artery was dominant; however, the posterior descending artery did not reach the cardiac apex. A large collateral channel between the acute marginal branch of the right coronary artery and the left anterior descending artery was displayed. It had a calibre equal to that of the right ventricular wall branch and distal left anterior descending artery. Smaller collateral vessels connected the posterior descending artery to the distal left anterior descending artery, the conus artery to the proximal left anterior descending artery, the sinoatrial node artery to the left atrial circumflex, and the distal right coronary artery to the distal circumflex artery. There was extensive collateral development in the inter-

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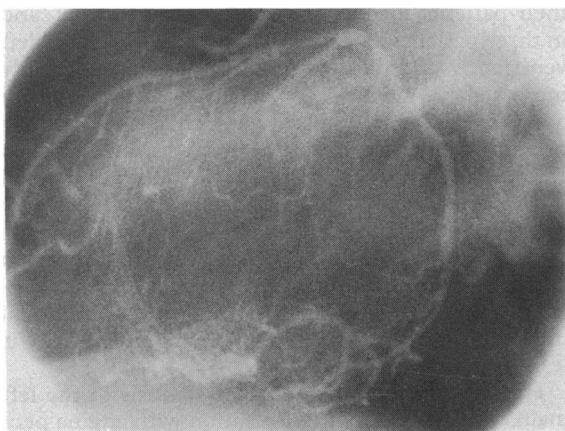
**Fig 1** Angiogram (left anterior oblique projection) obtained after injection of contrast into the right coronary artery in patient 1.

ventricular septum. There was a minor proximal right coronary artery stenosis with further lesions in the left anterior descending and circumflex arteries, which filled from the right coronary artery injection via the collateral channels described above (figs 1 and 2).

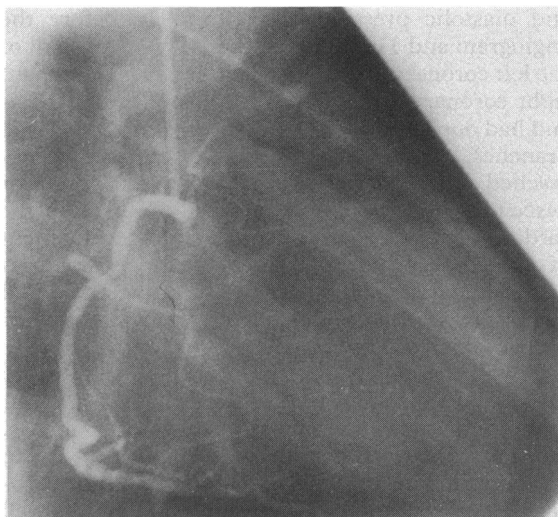
The patient steadfastly declined operation. Two years after cardiac catheterisation he continued to have stable effort angina pectoris, which he considered to be adequately controlled by medical treatment.

#### CASE 2

A 60 year old man was referred with a 16 month



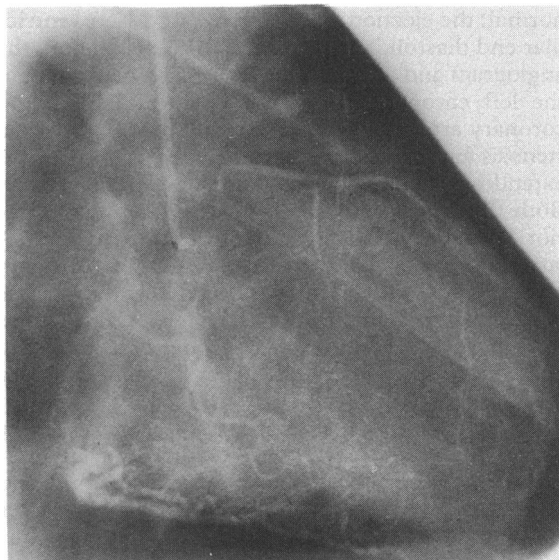
**Fig 2** Angiogram obtained in the late phase of the right coronary artery injection shown in fig 1, demonstrating filling of the left anterior descending and circumflex coronary arteries and extensive development of collateral vessels.



**Fig 3** Angiogram (right anterior oblique projection) obtained after injection of contrast into the right coronary artery in patient 2.

history of typical exertional angina of increasing severity despite medical treatment. Physical examination was unremarkable. An exercise test was positive.

At cardiac catheterisation slight apical hypokinesia was noted on the left ventricular angiogram. The ejection fraction was 50%. The left ventricular



**Fig 4** Angiogram of the late phase of the right coronary artery injection shown in fig 3, demonstrating filling of the left anterior descending coronary artery.

end diastolic pressure was 10 mm Hg before the angiogram and 11 mm Hg after it. The main stem of the left coronary artery was occluded. The dominant right coronary artery had a 40% proximal stenosis and had one large and two small left ventricular wall branches, and the posterior descending artery reached the cardiac apex. The left anterior descending artery was short and did not reach the cardiac apex. There was considerable development of epicardial and septal collateral channels. Stenoses were noted in the left anterior descending artery and circumflex arteries, which filled from the right coronary artery injection (figs 3 and 4).

This patient was referred for coronary artery surgery. Vein grafts were placed in the left anterior descending artery and one of its diagonal branches, the obtuse marginal branch of the circumflex, and in the posterior descending branch of the right coronary artery. Six months after operation he was well and symptom free.

#### CASE 3

A 49 year old man presented with a one year history of angina precipitated by cold or exertion. He had hypertension controlled by medical treatment. Physical examination was normal. The electrocardiogram showed left ventricular hypertrophy (SV1 + RV5 = 37 mm) and T wave inversion in leads I, aVL, and V2 – V6. Echocardiography confirmed mild concentric left ventricular hypertrophy.

At angiography the left ventricular angiogram was normal; the ejection fraction was 71%. Left ventricular end diastolic pressure was 10 mm Hg before the angiogram and 15 mm Hg after it. The main stem of the left coronary artery was occluded. The right coronary artery was dominant with a 30% proximal stenosis and two large left ventricular wall branches extending beyond the posterior descending artery. Both the posterior descending artery and left anterior descending artery reached the cardiac apex. A large collateral channel joined the right coronary artery conus to the left anterior descending conus branches, and numerous smaller collateral channels were also seen. The distal left anterior descending and circumflex arteries filled from the right coronary artery injection.

The patient was referred for coronary artery surgery. Vein grafts were inserted into the left anterior descending, diagonal, ramus medianus, and posterior descending arteries. Three months after operation he was symptom free.

#### Discussion

Occlusion of the left main coronary artery may be

associated with sudden death and with widespread myocardial infarction leading to cardiogenic shock and death or continuing severe disability. In contrast, the patients with left main coronary artery occlusion who we describe all had normal left ventricular ejection fractions and in only one patient was a minor focal abnormality of left ventricular contraction discernible on the left ventricular angiogram.

Preserved ventricular function when the left main coronary artery is occluded implies that the myocardium that is normally supplied by the left coronary artery receives a supply of oxygen and metabolic substrates from the right coronary artery that is adequate to maintain myocardial contractile function. In each of our three patients the right coronary artery was dominant and there were prominent epicardial and septal collateral vessels to the territories normally supplied by the left anterior descending and circumflex arteries. In patient 1 a large right ventricular wall branch of the right coronary artery was virtually continuous with the left anterior descending artery through a large collateral vessel.

It would seem reasonable to suggest that the basis for survival of the left ventricular myocardium in these patients depends on the presence of the dominant right coronary artery and development of epicardial and septal collateral vessels to supply distal branches of the left coronary artery.

We are aware of only one previous report of left main coronary artery occlusion with preserved left ventricular function.<sup>3</sup> These workers did not comment on the possible benefit of right coronary artery dominance in this context but the right coronary artery in one patient was said to be large. In two of their patients the ejection fraction was normal, and in three patients who were comparable with ours left ventricular end diastolic pressure was considerably increased (22–23 mm Hg), whereas in only one of our three patients was left ventricular end diastolic pressure raised to the same extent. Though they commented on the existence and functional importance of right coronary artery to left coronary artery collaterals in their patients, Frye *et al* gave no details of collateral development.<sup>3</sup> In the cases from both series the importance of intercoronary collaterals is convincing whereas the functional importance of coronary collaterals more generally is less certain.<sup>2</sup>

Haemodynamically important stenosis of the left main coronary artery in association with angina pectoris is an important indication for coronary artery bypass grafting<sup>4</sup>; such surgical intervention has been shown to improve symptoms and life expectancy. The place of operation in the management of

patients with left main coronary artery occlusion is less well defined. Patient 2 had a 40% proximal stenosis of the right coronary artery, which may reasonably be considered to be at least as important as a stenosis of the left main coronary artery, because not only are the left anterior descending and circumflex territories at risk if the vessel becomes occluded but also the right coronary artery territory. Patient 3 also had a minor stenosis of the right coronary artery, with similar implications in terms of the myocardium at risk. Thus in these patients coronary artery bypass grafting was carried out. Patient 1 had only trivial disease in the right coronary artery, and so the indications for operation were less clear cut than in the other two patients; but as the entire ventricular myocardium depended on continued patency of one vessel (the right coronary artery) coronary artery surgery was recommended. The patient refused this and two years after identification of the left main coronary artery occlusion, he continues to have stable effort angina. A similar patient reported by Frye *et al* also declined operation and had stable effort angina 2.5 years after angiography.<sup>3</sup> Perhaps left main coronary artery occlusion with a

normal right coronary artery carries a less adverse prognosis than left main coronary artery stenosis, and there may be consequent implications for surgical management; but at present too few data are available for firm conclusions to be drawn.

## References

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